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Program Management and Operations and Implementation Plan

POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM

GROUND SEGMENT SUPPORT
for the NOAA- N Argos 2 Instrument and NOAA N'
ADVANCED DATA COLLECTION SYSTEM (A-DCS) MISSION

Approved By

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On Behalf Of CNES

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On Behalf Of NOAA/NESDIS/OSDPD

The Centre National d' Etudes Spatiales (CNES)

Of France

And

The National Environmental Satellite, Data, and Information Service (NESDIS)

Of

The National Oceanic and Atmospheric Administration (NOAA)

Of the United States of America

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I SCOPE and PROGRAM

I.1 Scope

This project plan applies to the ground segment of the existing Argos 2 instruments through NOAA N on NOAA's Polar Orbiting Environmental Satellites (POES), and NOAA N' Argos 3 instrument known as the A-DCS. This project plan addresses data routing, format and hardware infrastructure from NOAA's Satellite Operations Control Center (SOCC) through NOAA's data distribution system at the CEMSCS to the data delivery system run by CNES subsidiary Collecte Localisation Satellites (CLS) Toulouse France or Service Argos Inc. Largo Maryland. The data format and delivery procedures apply for the legacy POES spacecraft flying Argos 1 and 2 instruments (NOAA 12, 14-17, and NOAA N). In addition this plan addresses the integration Advanced Data Collection System (ADCS) or Argos 3 to be flown on NOAA N' and the new technology equipment provided by CNES called the "Master Beacon" at the POES Fairbanks Alaska Command and Data Acquisition (FCDA) site. When the A-DCS is fully implemented, four Master Beacons will be installed at sites in Hatoyama (Japan), Toulouse (France), Fairbanks (USA) and Svalbard (Norway). Information on the space segment can be found in the Argos Advanced-Data Collection System Joint Project Plan signed September 2001 [RD-1}.

This Joint Project Plan reflects the cooperative agreements and activities established pursuant to the Memorandum of Understanding (MOU) between the National Oceanic and Atmospheric Administration (NOAA) and the *Centre National d'Etudes Spatiales* (CNES), signed on March 26, 1986, for the Argos Data Collection System (DCS) as amended to include the NOAA-N' mission and the new concept of "downlink messaging" [AD-1, AD-2, AD-3]. This MOU supersedes the December 1974 Memorandum of Understanding, and its amendment in 1984, between the National Aeronautics and Space Administration (NASA), NOAA and CNES for the provisions of the Television Infrared Observation Satellite-N (TIROS-N) series spacecraft to be the space-based platform for the Argos DCS instrument through the life of the NOAA Polar-orbiting Operational Environmental Satellite (POES) System.

I.2 Program Description

Argos Data Collection and Location System (DCS) is a satellite-based system, which provides a worldwide in-situ environmental data collection and Doppler-derived location service. The Argos mission is to advance earth system science worldwide by the application and enhancement of space based data collection and location technologies.
Argos was developed under a Memorandum of Understanding (MOU) between the Centre National d'Etudes Spatiales (CNES, the French space agency), the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration (NASA).

The system utilizes both ground and satellite-based resources to accomplish its mission. This includes instruments carried aboard the NOAA Polar-orbiting Environmental Satellites (POES), receiving stations around the world and major processing facilities in France and the United States. This fully integrated system works to conveniently locate and deliver data from the most remote platforms to the user's desktop, often in near real-time.

The Argos system is comprised of three interactive subsystems including the user Platform Transmitter Terminals (PTTs) or Argos Platform Message Transceivers (PMTs) starting with MetOp-1 2006, the Space Segment and the Ground Segment. Since 1978, the POES system has embarked Argos instruments as part of the space segment to receive and retransmit real time and stored information from the fixed and moving PTTs. In addition, the POES Ground Segment has provided the capability to receive, preprocess and distribute data to Argos regional and global processing centers. These centers are responsible for the actual processing, archiving and distribution to users all the environmental data collected by the Argos system.

The Argos-2 environmental monitoring instruments, provided by CNES, were one of the environmental monitoring systems integrated into the Advanced TIROS-N (ATN) fourth generation series of spacecraft, designated NOAA-G, -H, -I, –J, K, L, and M in accordance with the MOU. (It is noted that NOAA-D, a third generation spacecraft configured to replace NOAA-I, also embarks the DCS/2 instruments). Since becoming operational, the Argos system has continued to expand with NOAA and CNES, affirming their desire to extend their joint corporation on future NOAA spacecraft scheduled to be flown as the follow-on series of ATN spacecraft, NOAA-K, -L, -M, -N and then N'.

As part of the planning for the NOAA-N' spacecraft, CNES will provide and NOAA will integrate and fly a new Advanced Data Collection System (A-DCS) with a "downlink messaging" capability. This is made possible by changes in the DCS system to provide a wider receiver bandwidth, adding a new transmitter for transmitting messages to the PMTs on the ground, and adding additional Data Recovery Units (DRUs) extending the number of uplink messages that can be processed simultaneously. Implementation of these changes are further described in the "Joint Project Plan – Space Segment." for the A-DCS [RD-1]. It is noted that in the time-frame of the NOAA-N' planned launch, Argos A-DCS Space Segment instruments will also be flown on MetOp (Meteorological Operational) [RD-3] satellites operated by the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT).

I.3 PMOIP Change Procedure

NOAA and CNES will maintain the PMOIP through the process of creating amendments, proposed by either party. NOAA, as the depository of the plan, will produce and distribute amendments to users listed in the front of this plan.

II. Organization and Responsibilities

NOAA and CNES, through the Argos Operations Committee, manage the DCS/A-DCS jointly. Roles and responsibilities for the Argos program are defined in the Memorandum of Understanding between NOAA and CNES amended 1996. The Argos instruments are scheduled to become operational on other satellite space platforms (Ex. MetOp), which are not covered by the scope of this document or the MOU between NOAA and CNES.

Responsibility of the Participating organizations involved in implementing, operating and maintaining the A-DCS "Message Forwarding" capability within the POES Ground Segment to support the mission requirements for the NOAA-N' spacecraft are described herein.

II.1 CNES Ground Segment

The CNES is responsible for processing and distributing Argos sensor data received from all receiving stations around the world including their HRPT network, and Stored and forwarded data delivered by NOAA.

The CNES will be responsible for the design, manufacture, test and delivery of the Argos Master Beacon to the NOAA FCDA site to agreed specifications. CNES will conduct facility site surveys at the FCDA site, arrange and procure all necessary site installation support capabilities and provide for the installation, checkout and testing of all Argos mission equipment at the FCDA site. CNES will also put in place long term agreements for the maintenance of the Argos mission equipment installed at the FCDA site for the duration of the N' mission.

The CNES will be responsible for managing Argos operations involving "message forwarding" to support user services.

II.2 NOAA

NOAA will be responsible for operating and maintaining the POES system, with the Argos-2 on NOAA-N and A-DCS system embarked on the NOAA-N' spacecraft for the duration of their operational missions.

NOAA will make available stored data received through their CDA sites at Wallops Island Virginia and Fairbanks Alaska to CNES subsidiary CLS Global Processing center in Landover Maryland and Toulouse France.

NOAA will provide access to its facility at the FCDA site to support facility site surveys, the coordination of construction and installation activities and for the maintenance of the Argos mission equipment installed at the site.

NOAA will seek to minimize changes to the POES Ground Segment and the interface specifications for the duration of the N' mission.

II.3 Organization

The PMOIP oversight is managed

- NOAA Polar Program Project Manager
- NOAA Argos Program Manager
- CNES Project Manager
- CNES Ground Segment Project Manager

The present holders of the positions cited above are listed in Appendix C. The Oversight members will meet as necessary. If requested, they will inform the ARGOS Operations Committee on implementation details to ensure that the necessary coordination is maintained between on-going operations and future developments.

II.4 Information Exchanged in Confidence

Each participant will take all lawful steps available to it to keep free from disclosure without the consent of other participants any technical information exchanged in confidence relating to the design of equipment supplied under this cooperative project. Any participant providing information considered by that participant to be a trade secret, or commercial or financial information that is privileged or confidential, shall request in writing at the time the information is provided to the other participants that the information be given confidential treatment.
Information subject to a request for confidential treatment must be clearly marked with a legend indicating the country of origin, conditions of release, information related to this cooperative project, and that it is furnished in confidence.

III Argos Instruments

III.1 Argos Instruments on Previous POES Missions (NOAA 12, 14-17 and NOAA N)

The Argos-1 instrument is presently operational and will remain unchanged until the end of NOAA-12 and 14 operational lives.
The Argos-2 instrument was designed and optimized based on the random access concept, i.e. short unidirectional messages (< 1 s) with a high time interval (> 60 s) and a low bit rate (400 bps). This concept allows simple platforms, a low energy consumption and hence, the possibility to develop economical and/or mini-platforms.
The Argos-2 instrument performances were designed to meet the mission requirements until the end of the NOAA-15, 16, NOAA-17, and N operational life. According to the expected launch schedule, the last satellite of the Argos-2 mission (NOAA-N) was launched May 2005.

III.2 Advanced Data Collection System (A-DCS) Instruments

The Advanced Data Collection System (A-DCS) is the follow-on of Argos-1 and Argos-2. In addition to collecting data from moving or fixed observation stations called Platform Transmitter Terminals (PTTs) like Argos-1 and Argos-2, the major improvements over the Argos-2 system provided by the new A-DCS data collections system are:

- full ascendant compatibility with Argos-1 and Argos-2
- addition of an on-board transmitter and antenna to support the “downlink messaging” capability
- increased receiver bandwidth from 80 kHz to 110 kHz
- processing of 3 types of beacons (Argos-2 type @ 400 bps, high sensitivity type @ 400 bps and high data rate type @ 4800 bps)
- reduced number of boxes (e.g. RPU, DPU, etc..) from three to two full cold redundancy of the instrument (not redundant on Argos-1 and Argos-2)

However, one of the disadvantages is increased satellite power requirements (more than two times the power demand of Argos-2) primarily driven by the addition of a new transmitter and additional DRU’s.

The A-DCS will have the capability to receive messages from fixed ground transmitters known as “Master Beacons” and then relay these messages to in-situ PMTs. Note: PMTs are newer generation PTTs in that they can receive as well as transmit message data. PTTs and PMTs are generally referred to as Data Collection Platforms (DCPs) offering advanced capabilities beyond that of the older PTTs.

III.3 A-DCS Program Objectives

-- To insure the continuity of the system with the present platforms. It is essential to use compatible platform types so as to preserve the chances of implementing variants of a random access such as currently used with first-generation instruments. The bandwidth of the Argos-1 receiver is 24 kHz, Argos-2 is 80 kHz, and the receiver bandwidth of the A-DCS is 110 kHz. The way of using the bandwidth and hence, the additional capacity brought by the future A-DCS instrument, will be controlled according to the user needs.
-- To improve the performance of the Argos system in terms of overall data collection capability, through the introduction of a new kind of platforms: the high data-rate transmitters.
-- To provide a better sensitivity owing to a new kind of platform called PMTs Platform Messaging Transceivers. These PMTs have the capability of low-power consumption.
-- To provide users with the downlink message function, namely a UHF space-to-earth link dedicated to the transmission of messages to the Argos platforms fitted with appropriate receivers. It will be possible to modulate the length of the messages according to the user needs.

III.4 A-DCS system Components

-- The users' DCPs located worldwide collect and provide environmental information such as wind/ocean currents velocity and direction or local temperature. The system is able to handle up to 900 DCPs simultaneously with a 91 percent probability for successful localization; the Users ground DCP system is composed of about 15000 DCPs worldwide localized by Doppler shift information.

-- The on board A-DCS Instrument, which receives uplink data from DCPs, measure both Doppler frequency and relative time of occurrence of each transmission. The global data is both stored and transmitted to NOAA's Command Data Acquisition (CDA) Stations once in the field-of-view of the CDA receive station circle or transmitted via the real-time High Resolution Picture Transmission (HRPT) downlink to HRPT stations worldwide. The A-DCS also transmits to the PMTs (equipped with receiver), the downlink messages via the A-DCS transmitter.

-- The NOAA-N' spacecraft platform, which provides the data handling system that processes and formats to all payload and housekeeping telemetry data. In addition, the NOAA-N' platform provides the necessary hardware such as receive/transmit antennas, diplexers, RF filters, and cables needed by the A-DCS for both data downlink and uplink communications to the ground.
-- The NOAA CDA Ground segment, which receives the A-DCS raw data acquired during one orbit and transmits it to the NESDIS Central Environmental Satellite Computer System (CEMSCS) for pre-processing.

-- The CNES data processing facilities for post-processing of the data and distribution to the End Users.

III.5 Autonomous Commanding Safeguards

CNES assures NOAA that CNES will not have the capability to send commands through the Master Beacon to the A-DCS that will change its mode of operation or affect the health and safety of the spacecraft.

IV. Ground Segment Support for POES Program Through NOAA N'

IV.1 Ground Segment Support Summary

During operations with the POES system, NOAA is responsible for activities associated with the acquisition and distribution of all environmental mission data from the POES system. Argos DCS/2 data recovery units embarked on POES spacecraft receive environmental information from fixed and moving PTTs within the satellite's area of coverage, approximately a 5000 km circle. The orbital data collected by the satellite is processes and then transfers via the spacecraft's data handling system (DHS) to the ground segment in three modes. These modes include real-time S-band communications {when the satellite is in view of a command and data acquisition (CDA)} site, TIROS Information Processor (TIP) data stored on digital tape recorders

(DTRs) and transmitted via S-band communications (scheduled download of satellite orbital data over CDA sites), and via real time VHF beacon communications.

The POES ground segment monitors the health and safety of satellites and schedules and transmits commands for their proper operation and downloading of mission data. The ground segment also receives all POES mission data and processes and distributes products to users. For Argos, orbital data files are provided to CNES for mission processing and distribution as required.

IV.2 NOAA Ground Segment Support Facilities

The POES CDA ground stations at Wallops Island and Fairbanks receives all POES mission data and forward it to Suitland Maryland to NESDIS's Satellite Operations and Control Center (SOCC) via commercial communication links. The SOCC forwards the Argos DCS data to the Central Environmental Satellite Computer Center (CEMSCS) for processing and distribution. At CEMSCS, Argos DCS orbital data is stripped out of the data stream and forwarded to Argos regional and global processing centers in Largo, Maryland, and Toulouse, France. Under the responsibility of CNES, these centers process Argos data received from all receiving stations; archive results, and makes the information available to users. Data handling and formats are covered under section V of this document.

The current Argos ground segment architecture is shown in Figure 1.

IV.3 CNES Argos DCS Support Facilities

IV.3.1 Global centers

There are two Global Processing Centers (GPCs), one in Toulouse, France, and one in Largo, MD, USA. These centers are the hub of the Argos ground segment architecture. Their main missions are to:

- process all Argos telemetry from all satellites and receiving stations;
- process and distribute data acquired from all Argos Platform Transmitter Terminals (PTTs), in identical fashion;
- monitor system technical parameters;
- perform vital system operation tasks (orbit determination, time-tagging, etc.).

The two GPCs operate concurrently but independently. So if one GPC goes down, the other will back it up.

Because both GPCs receive all the satellite telemetry simultaneously, they do not depend on each other. This is important in ensuring uninterrupted service in the event of an incident, assuming that the probability of both GPCs being down at the same time is nil.

In particular, the GPCs must run identical processing systems concurrently. Although this may seem obvious, it is far from easy to implement, requiring effective configuration management, common hardware and software policies at both centers, and strict application of the same corrective software maintenance and revision procedures.

Each GPC must also support location of and data collection from all Argos PTTs, and they must perform the task in the same way. This means that each time a GPC receives new information on PTT processing requirements, it must relay that information immediately to the other GPC to maintain data consistency and transparency for users.
Last, but not least, each GPC is operated by its own highly trained team. Neither Center is master or slave, nor is there redundancy provided by a “standby” center, which is waiting to come on line if the nominal GPC fails. Both centers perform the same tasks independently using identical resources.

If one of the GPCs goes down, continuity of service is easily ensured by re-routing incoming calls to the other. And as the two GPCs are linked by a leased line, users do not incur extra long-distance communication costs.
Lastly, each GPC provides high availability and performance through hardware clustering, RAID 0+1 disk architectures and backed up communications links connected to dedicated routers.

The one exception to redundant operations is the management of the Master Beacon network and user messaging services. The DMMC (Downlink Messaging Management Center) function is ensured only by the Toulouse GC. This function concerns the downlink management through the Master Beacons and in order to not disturb the system can be driven by only one of the GCs

IV.3.2 Regional centers

Regional Processing Centers (RPCs) provide users with local access to Argos results. RPCs process data from PTTs operating in their region but also other beacons, which have been included in their system.

RPCs process telemetry from the regional receiving stations to which they are directly connected but also stored telemetry relayed by the GCs after pre-processing. The post-processing of the stored telemetry is then performed by the RPC.
In all cases, as GC processes and distributes data from all PTTs, it relays location and sensor data to each RPC for all PTT managed by the RPC.
One PTT message is then processed a lot of time either by the GPCs, or by the RPCs, in order to obtain the better service in term of quality (smaller location error) and speed.

RPCs provide the same location accuracy as the GPCs. They can do this because they use the same processing software, and because the GPCs send satellite ephemeris data daily to the RPCs. GPCs perform all satellite orbit determination computations and other processing-intensive tasks.

RPCs are not backed up in the same way as the GPCs. In particular, they are not staffed round the clock. RPCs are managed and monitored remotely from the Toulouse center, which backs them up in the event of a failure.

IV.3.3 NOAA's Main ground receiving stations

There are two main ground stations, in Fairbanks (USA), and Wallops Island (USA). The stations are operated by NOAA/NESDIS Office Satellite Operations. These stations are called "main ground stations" as they receive all messages recorded by the satellites during a complete orbital revolution. Argos thus provides global coverage.

Ground stations are run and maintained by operational organizations to ensure high reliability and full compatibility with the Argos system.

IV32.4 CNES Regional HRPT receiving stations

If the data platforms and receive site are simultaneously in the view of the satellite, the Data Collection System provides the immediate rebroadcast of data from the platform, received by the satellite via an UHF uplink. These data are included as 32 8-bit words in the TIP minor frame. As such, it is available in both the low data rate DSB and high data rate HRPT services. Since the data rate on the new DCS/2 instrument has been increased from 1200 to 2560 bps, the number of TIP words allocated to DCS has been increased to 32 from the previous spacecraft series. However, interpretation of the telemetry remains unchanged. The DCS data in the direct broadcast services will only permit platform location computations with the proper computer software. CLS/SAI operates 41 HRPT site globally. In addition the ground stations at Fairbanks Alaska and Wallops Island Virginia also act as regional receiving stations.

Not all regional receiving stations are owned by CLS but rather by National Weather Services (Bureau of Meteorology in Australia, MetOffice in New Zealand, Météo-France in Réunion Island, etc.) which use them mainly to acquire and process AVHRR satellite imagery. They do not guarantee absolute operational reliability, but in practice performance has proved very satisfactory. To offset the possibility that a station might become unavailable, we constantly strive to extend the network of regional receiving stations. In this way, less than 100% reliability is counterbalanced by the large number of access points. A list of the current HRPT network is in Appendix F

IV.3.5 Communication networks

The wide variety of communications networks and equipment receiving telemetry for processing and distribution of results to Argos users is a crucial element of the ground segment. These resources include leased links, the Internet and public X.25 networks. The main protocols are TCP/IP and X.25.

The two GPCs are interconnected by the Internet, itself backed up by an ISDN line. Communications with the ground stations in Fairbanks and Wallops Island run over dedicated links mostly belonging to NOAA.

Communications with regional receiving stations run over the Internet. It is common knowledge that the Internet is risky and far from reliable. So why do we use it? In fact, it is the only available network offering such easy access to all regional receiving station operators. Once again, likely problems can be overcome thanks to the large number of receiving stations.

Today, most users communicate with Argos over the Internet using SMTP, Telnet, FTP and HTTP. Direct PSTN links have been dropped in favor of SMTP messaging. Where users need enhanced reliability, we suggest public X.25 networks, which are widely available worldwide and offer outstanding availability, but such services are not cheap. Fax and telex are also used for specific applications.

IV.3 Ground Segment Support for A-DCS and The Master Beacon

With the A-DCS to be embarked on the NOAA-N', the acquisition, processing, and distribution of mission data will be implemented as described in paragraph 3.1.

With the "forward messaging" capabilities, inherent in the A-DCS, a new interface is created between the Downlink Messaging Management Center (DMMC) in Toulouse, France, and the POES space segment through the master beacon to be installed at the FCDA site. CNES will use this interface to upload to the Argos instruments, installed on the spacecraft, the messages to be downloaded to the user PMTs. These messages will serve to manage the operations of the instrument with respect to its contacts with PMTs, and not introduce changes to the Argos equipment controlled by NOAA as part of its satellite operations responsibilities described in paragraph 3.1.

The "forward messaging" capability for the A-DCS will require that a new master beacon capability be installed at the FCDA site. This will involve installing additional antennas and racks of equipment, and making use the local communications capabilities at the site. The proposed changes in the POES Ground Segment at the FCDA site will be implemented as described in the following phases. They are the Site Planning Phase, the Site Activation Phase, the Communications Access Phase, and the site Test and Evaluation Phase. Quality Assurance Standards and Configuration Control Procedures for equipment to be installed at the site and for work accomplished at the site are also discussed.

The future Argos ground segment architecture is shown in Figure 2.

IV.3.1 MASTER BEACON Site Planning Phase

The site planning phase will be initiated in parallel with the development phase for the Argos Master Beacon, and culminate with the start of the site Activation Phase. The objective of this phase will be to gather site-specific information as required to document, develop, procure and integrate all Argos equipment for the FCDA site.

CNES is responsible for the overall development of the master beacon for use at the FCDA site. As part of the systems engineering process for development of the master beacon, CNES will conduct site surveys at the FCDA site to gather information on the site as require to install, interface, and operate Argos equipment in the site's environment. CNES will then complete the design for the master beacon and any of its related equipment required to mount, secure, interface, connect, protect, or test the final integrated unit at the site to support Argos performance and design requirements [AD-4]. As part of the development process, CNES will conduct design reviews, and prepare documentation and dawning's as required to coordinate and implement installation activities at the FCDA site. A final set of “as built” technical specifications and drawings will be provided to the site as part of their baseline documentation.

NOAA is responsible for supporting the overall development process for the Argos Master Beacon. This includes providing access to assess the existing space, facilities, communications, and operational environment at the FCDA site. NOAA will also support design reviews as required and provide coordination on documents and drawings that reflect the installation details for the site.

IV.3.2 Master Beacon Activation Phase

The Activation Phase will begin with the arrival of the Argos Master Beacon equipment and CNES' installation team at the FCDA site. During this phase all Argos equipment will be installed and power-on and self-checks completed
CNES will deliver all Argos Master Beacon equipment to the FCDA site necessary to complete its installation and checkout activities in accordance with the schedule shown in Figure (TBS). CNES will provide installation and checkout crews necessary to receive equipment at the site, complete all unpacking and assembly activities, and to install, connect, and to power-up and complete self-checks for all Argos site equipment.

NOAA will provide space for receipt, unpacking, and assembly of Argos equipment at the FCDA site. NOAA will monitor and or witness site activation phase activities at the site to coordinate and assist in the completion of all phase activities.

IV.3.3 Downlink Communications Access Phase

The Communications Phase will be conducted in parallel with the site Test and Evaluation Phase. During this phase, communications related activities will (1) verify file transfer protocol (FTP) message format connectivity from the master beacon via access through the site local network to the DMMC; (2) verify the connectivity from the master beacon to the Argos antenna assembly, and (3) verified the connectivity between the master beacon and the DMCC via a telephone connections.

CNES will identify and provide procedures for verifying the physical and applications layers of the communications links between the DMCC and the master beacon installed at the FCDA site. CNES will then verify the communications links from the master beacon to the Argos antennas installation. End-to-end continuity and messaging format tests will then be completed. CNES will also verify the connectivity between the master beacon and the DMMC via a telephone line to send and receive remote control and maintenance data message formats.

NOAA will coordinate and support all communications test requiring the use of the local network and telephone connections at the site.

IV.3.4 Downlink Messaging and Master Beacon Test and Evaluation Phase

The Test and Evaluation Phase will provide verification and validation of the changes installed at the FCDA site to support the ADCS mission.

CNES will conduct test as required to verify and validate that the Argos equipment installed at the FCDA site will support Argos performance and design requirements [AD-4]. Test procedures will be prepared and coordinated with NOAA prior to their being implemented. A test report will be prepared documenting all test results and provided to the site as part of their baseline documentation.

NOAA will support all tests planned at the FCDA site as required by coordinated test plans.

IV.3.5 Master Beacon Quality Assurance Standards

CNES will be responsible for the overall quality assurance standards to be implemented on the Argos program. During the site surveys to the FCDA site, all unique North American design or quality standards that must be met to ensure site compatibility will be identified and implemented as part of the Argos program. CNES quality assurance procedures will then be followed to validate compliance with all requirements approved on the program.

IV.3.6 Master Beacon Configuration Control Procedures

Program responsibility for the master beacon equipment installed at the FCDA site will remain with CNES for the duration of the Argos mission. All proposed changes to the master beacon equipment will therefore be forwarded CNES for processing and disposition. NOAA will be provided copies of all changes to the master beacon equipment for review and comment.

IV.4 COMMAND COMMUNICATIONS

[Summary]

IV.4.1 Describe the notification process for changes to the data processing system or spacecraft, which affect the DCS instrument and its data.

IV.4.2 Describe the procedure for receiving questions/commands from the user (CNES-CLS/SAI) for the DCS instrument or data processing/delivery.

V. DATA FORMATTING

The data formatting for the POES program follows the Consultative Committee for Space Data Systems (CCSDS) format. CCSDS is the adopted format of the Coordination Group for Meteorological Satellites (CGMS) and is detailed in [RD-7]. CCSDS data is down linked at the NOAA ground receiving stations and collected at the Satellite Operations Control Center (SOCC) in Suitland Maryland. The SOCC then forwards the data to the CEMSCS for processing and distribution.

V.1 OSDPD/CEMSCS Data Delivery Architecture

The Office of Satellite Data Processing and Distribution (OSDPD) receives NOAA satellite data from the SOCC. The SOCC ships the raw data, which is in level 1A format to OSDPD Integrated Processing division (IPD), where the DCS data is stripped out of the AIP or TIP for pre K satellites. The Level 1A data is then fed into the preprocessor to produce level 1B formatted DCS data. Normally Level 1B data is raw data with calibration and earth location appended. In the case of DCS, no calibration or earth location is done. For DCS, OSDPD/IPD passes on the telemetry data and quality assurance information. The level 1B data is sent out to the users.

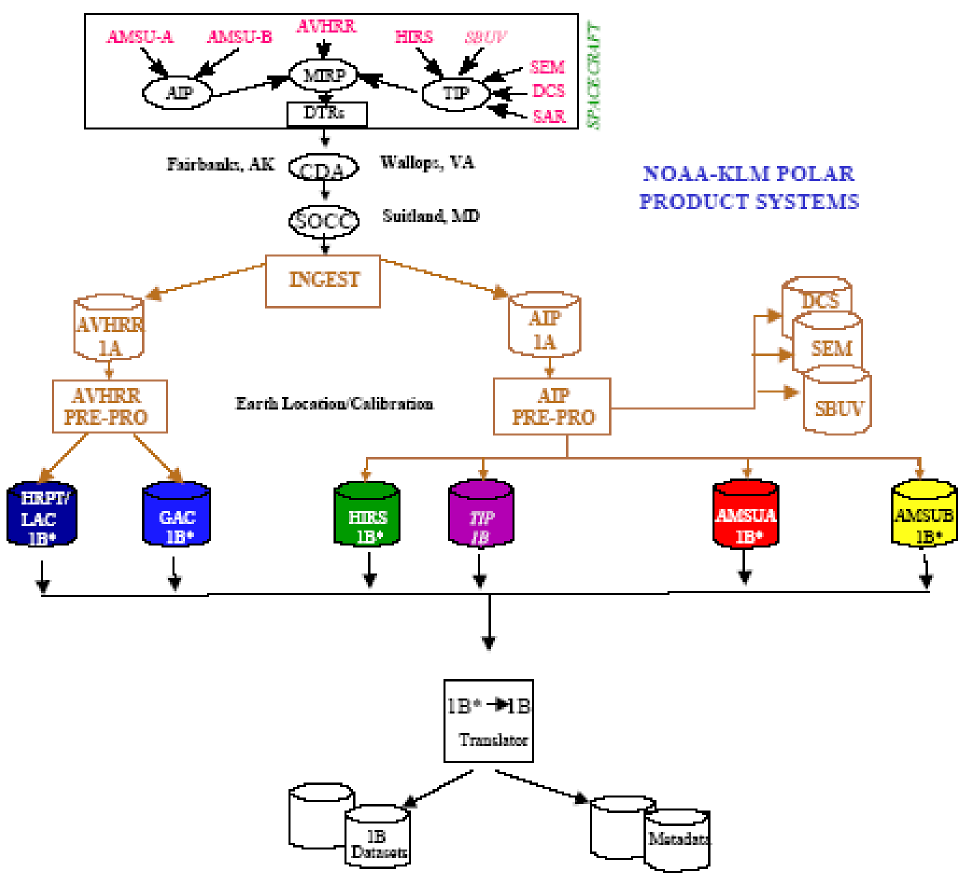

Figure 1. NOAA-KLM Preprocessor

Below is the KLM documentation of the DCS level 1B format. This identifies the data shipped in the 1B files to Service Argos. KLMDCSH.WP5 is the format for the header record and KLMDCSD.WP5 is the format for the data record. These formats are not fixed and are updated periodically. For more information on POES data formats please visit the following web site: http://www2.ncdc.noaa.gov/docs/klm/html/c8/s83-1.htm

Also, attached is a current list of the actual files remaining on our system that were created and shipped. It shows a complete listing for March 9 (day 68) and partial lists for day 67 and 69. If you focus on those files with names NSS.DCS_.N_.D03068... you will see a snapshot of what is normally sent out. A description of the data set naming convention can be found at the following web site:
http://www2.ncdc.noaa.gov/docs/klm/html/c8/s8-2.htm
This document also contains general information about the level 1B data, but no specifics about DCS.

NOAA-17 (NM) and NOAA-16 (NL) are the primary and secondary spacecrafts respectively. Those files with NSS.DCSX... names are the normal operational data pulled from the GAC (AVHRR) data stream. You will find files for every orbit unless there was a problem. A file can contain up to 115 minutes of data. You should see a few minutes of overlap in the data when comparing the start and end times of the consecutive files.

NSS.DCSS data files were produced from stored TIP data (STIP) recorded on the spacecraft. These are provided as requested or in the place of the DCSX data when necessary.

NSS.DCSH data are taken from the HRPT (AVHRR) data stream and are provided upon request. These are short data sets since they are formulated from direct readout data taken when the spacecraft was in range of the CDA (Command and Data Acquisition) station. The station name is provided at the end of the data set name (WI - Wallops Island, Va.; GC - Gilmore Creek, Fairbanks, Alaska; MO - Monterey, Calif.). The maximum length of these files is about 15 minutes. This data should be found in the DCSX data. It isn't planned for the format to change much for the DCS instrument in IJPS era. The data is currently pushed to Argos in Landover and to France.

KLMDCSH.WP5
NOAA-K/L/M Series Polar Orbiting Environmental Satellite
NOAA/NESDIS Level 1b Data Collection System 2 (DCS-2) Format

Revision History:
12/13/94 kvj #1
07/24/95 gpg #2merged second header record with first; redefine Julian Day
10/17/95 gpg #3add instrument ID; reallocate filler; move calibration parameter ID to general section; add year and day of year for CPIDS update; relocate calibration section
11/08/96 gpg #4add creation site ID (Saunders, 11/08/95 & 02/15/96); reorder constant roll/pitch/yaw error fields; change scaling on navigation fields to support greater accuracy (Harrod, 02/21/96); add reference ellipsoid model ID;

add ‘reasonableness test active’ bit to navigation earth location bit field (Jarva, 01/26/96); change count and bit fields to unsigned integer (DT=u); change scan line count to data record count; add instrument status and status change fields; add ingester and decommutation reserved fields; adjust zero fill to align on I*8 boundaries

12/23/96 gpg #5remove navigation and calibration sections (Derrien, 11/27/96)

Record 1: Header Record 1

Start Byte	End Byte	DT	Word Size	SF	Number of Words	*GENERAL INFORMATION*
1	3	c	3	0	1	Data Set Creation Site ID
4	4	c	1	0	1	<ASCII blank = x20>
5	6	u	2	0	1	Level 1b Format Version Number
7	8	u	2	0	1	Level 1b Format Version Year
9	10	u	2	0	1	Level 1b Format Version Day of Year
11	12	u	2	0	1	<Reserved for Logical Record Length>
13	14	u	2	0	1	<Reserved for Block Size>
15	16	u	2	0	1	Count of Header Records in this Data Set
17	22	i	2	0	3	<Zero Fill>
23	64	c	42	0	1	Data Set Name
65	72	c	8	0	1	Processing Block Identification
73	74	u	2	0	1	NOAA Spacecraft Identification Code
75	76	u	2	0	1	Instrument ID
77	78	u	2	0	1	Data Type Code (1 = LAC; 2 = GAC; 3 = HRPT; 4 = TIP; 5 = HIRS; 6 = MSU; 7 = SSU; 8 = DCS; 9 = SEM; 10 = AMSU-A; 11 = AMSU-B)
79	80	u	2	0	1	TIP Source Code (0 = not applicable; 1 = GAC embedded; 2 = stored; 3 = third CDA; 4 = HRPT embedded)
81	84	u	4	0	1	Start of Data Set Day Count from 00h, 1 Jan 1950

85	86	u	2	0	1	Start of Data Set Year
87	88	u	2	0	1	Start of Data Set Day of Year
89	92	u	4	0	1	Start of Data Set UTC Time of Day in Milliseconds
93	96	u	4	0	1	End of Data Set Day Count from 00h, 1 Jan 1950
97	98	u	2	0	1	End of Data Set Year
99	100	u	2	0	1	End of Data Set Day of Year
101	104	u	4	0	1	End of Data Set UTC Time of Day in milliseconds
105	106	u	2	0	1	Year of Last CPIDS Update
107	108	u	2	0	1	Day of Year of Last CPIDS Update
109	110	c	2	0	1	Calibration Parameter Identification
111	116	i	2	0	3	<Zero Fill>
117	116					***DATA SET QUALITY INDICATORS***
117	120	u	4	0	1	Instrument Status bits 31 - 16: <zero fill> bit 15: relay A status bit 14: relay B status bit 13: DRU 1 bit 12: DRU 2 bit 11: DRU 3 bit 10: DRU 4 bit 9: DRU 5 bit 8: DRU 6 bit 7: DRU 7 bit 6: DRU 8 bit 5: Memory Overflow bit 4: DCS Time Code (msb) bit 3: Pseudo message status bits 2-0: <zero fill>
121	122	u	2	0	1	Record Number of Status Change (if 0, none occurred)
123	124	u	2	0	1	Count of Data Records in this Data Set
125	126	u	2	0	1	Count of Data Gaps in this Data Set

127	128	u	2	0	1	Count of Data Frames Without Frame Sync Word Errors
129	130	u	2	0	1	Count of PACS Detected TIP Parity Errors
131	132	u	2	0	1	Sum of All Auxiliary Sync Errors Detected in the Input Data
133	134	u	2	0	1	PACS Status Bit Field bit 2: pseudo noise (0 = normal data; 1 = P/N data) bit 1: tape direction (0 = time decrementing) bit 0: data mode (0 = test data; 1 = flight data)
135	136	u	2	0	1	PACS Data Source (0 = unused; 1 = Gilmore; 2 = Wallops; 3 = SOCC)
137	144	c	8	0	1	<Reserved for the Ingester>
145	152	c	8	0	1	<Reserved for Decommutation>
153	168	i	4	0	4	<Zero Fill>
169	168					***ANALOG TELEMETRY CONVERSION***
169	238	i	2	0	35	Conversion Coefficients for Analog Housekeeping Telemetry (five consecutive 16-bit words per telemetry field) *Words 1 - 5*: type 1 telemetry transfer coefficients *Words 6 - 10*: type 2 telemetry transfer coefficients *Words 11 - 15*: type 3 telemetry transfer coefficients *Words 16 - 20*: type 4 telemetry transfer coefficients *Words 21 - 25*: type 5 telemetry transfer coefficients *Words 26 - 30*: type 6 telemetry transfer coefficients *Words 31 - 35*: type 7 telemetry transfer coefficients
239	10752	i	2	0	5257	<Zero Fill>

KLMDCSD.WP5
NOAA-K/L/M Series Polar Orbiting Environmental Satellite
NOAA/NESDIS Level 1b Data Collection System 2 (DCS-2) Format

Revision History:
12/13/94 kvj #1
07/24/95 gpg #2fixed typo in analog telemetry word 3 description (Derrien, 05/09/95); added satellite clock drift delta field.
10/17/95 gpg #3reallocate filler; move minor frame data section
12/23/96 gpg #4allocate four spare words to analog telemetry (Derrien, 05/09/96 & 11/27/96); move satellite clock drift delta field; change count and bit fields to unsigned integer (DT=u); define quality indicator field; define major frame quality flags; relabel 'Major Frame Count' to 'Major Frame Record Count' to clarify cumulative nature; fully define DCS Minor Frame Data field; add invalid word bit flags for Dig B and analog telemetry fields; realign on I*8 boundaries

Record n+1 - <end of file>: Data Record

Start Byte	End Byte	DT	Word Size	SF	Number of Words	*FRAME INFORMATION*
1	2	u	2	0	1	Major Frame Record Count
3	4	u	2	0	1	Major Frame Year
5	6	u	2	0	1	Major Frame Day of Year
7	8	i	2	0	1	Satellite Clock Drift Delta in milliseconds
9	12	u	4	0	1	Major Frame UTC Time of Day in milliseconds
13	14	u	2	0	1	Major Frame Bit Field bit 15: 0 = northbound data; 1 = southbound data bit 14: 1 = scan time corrected for clock drift bits 13-0: <zero fill>
15	24	i	2	0	5	<Zero Fill>
25	24					***QUALITY INDICATORS***
25	28	u	4	0	1	Quality Indicator Bit Field If a bit is on (=1) then the statement is true. bit 31: do not use frame for product generation bit 30: time sequence error detected within

						this frame (see below) bit 29: data gap precedes this frame bits 28 - 27: <zero fill> bit 26: first good time following a clock update (nominally 0) bit 25: instrument status changed with this frame bits 24 -1: <zero fill> bit 0: takes the value of the data fill bit (bit number 27) of the TIP quality indicator
29	32	u	4	0	1	Major Frame Quality Flags If a bits is on (=1) then the statement is true. *Time Problem Code* (All bits off implies the frame time is as expected.) bits 31 - 24: <zero fill> bit 23: time field is bad but can probably be inferred from the previous good time. bit 22: time field is bad and can't be inferred from the previous good time. bit 21: this record starts a sequence that is inconsistent with previous times (i.e., there is a time discontinuity). This may or may not be associated with a spacecraft clock update. (See bit 26, Quality Indicator Bit Field) bit 20: start of a sequence that apparently repeats frame times that have been previously accepted. bits 19 - 0: <zero fill>
33	40	i	4	0	2	<Zero Fill>
41	40					***DCS MINOR FRAME DATA***
41	10280	u	1	0	10240	Major Frame Each data record contains one major frame containing the 320 DCS-2 minor frames transmitted in a 32 second cycle. The instrument data is stored as received in thirty-two 8-bit words per minor frame. *Word 1*: TIP Minor Frame 0 Word 18 ...

						(TIP Minor Frame 0 Words 19, 24, 25, 28, 29, 32, 33, 40, 41, 44, 45, 52, 53, 56, 57, 60, 61, 64, 65, 68, 69, 72, 73, 76, 77, 86, 87, 90, 91, 94) ... *Word 32*: TIP Minor Frame 0 Word 95 *Word 33*: TIP Minor Frame 1 Word 18 ... *Word 10240*: TIP Minor Frame 319 Word 95
10281	10284	i	4	0	1	<Zero Fill>
10285	10284					***DIGITAL B TELEMETRY***
10285	10286	u	2	0	1	Invalid Word Bit Flags (if bit = 0, associated telemetry value is valid) bit 15: Relay A Status bit 14: Relay B Status bit 13: DRU 1 bit 12: DRU 2 bit 11: DRU 3 bit 10: DRU 4 bit 9: DRU 5 bit 8: DRU 6 bit 7: DRU 7 bit 6: DRU 8 bit 5: Memory Overflow bit 4: DCS Time Code msb bit 3: Pseudo Message Status bits 2-0: <zero fill>
10287	10288	u	2	0	1	Digital B Telemetry bit 15: Relay A Status bit 14: Relay B Status bit 13: DRU 1 bit 12: DRU 2 bit 11: DRU 3 bit 10: DRU 4 bit 9: DRU 5 bit 8: DRU 6 bit 7: DRU 7 bit 6: DRU 8 bit 5: Memory Overflow

						bit 4: DCS Time Code msb bit 3: Pseudo Message Status bits 2-0: <zero fill>
10289	10292	i	4	0	1	<Zero Fill>
10293	10292					***ANALOG TELEMETRY***
10293	10294	u	2	0	1	Invalid Word Bit Flags (if bit = 0, associated telemetry value is valid) bit 15: <zero fill> bit 14: Word 14 ... bit 1: Word 1 bit 0: <zero fill>
10295	10308	u	1	0	14	Analog Telemetry *Word 1*: RPU Temperature (use type 1 transfer coefficients) *Word 2*: SPU-A Temperature (use type 1 transfer coefficients) *Word 3*: SPU-B Temperature (use type 1 transfer coefficients) *Word 4*: Converter Voltage +5V (use type 2 transfer coefficients) *Word 5*: Converter Voltage +12V (use type 3 transfer coefficients) *Word 6*: Converter Voltage -5V (use type 4 transfer coefficients) *Word 7*: Converter Voltage -12V (use type 5 transfer coefficients) *Word 8*: Converter Temperature (use type 1 transfer coefficients) *Word 9*: USO Oven Temperature (use type 6 transfer coefficients) *Word 10*: USO Thermal Regulation (use type 7 transfer coefficients) *Words 11 - 14*: <Zero Fill>
10309	10308					***FILLER***
10309	10752	i	4	0	111	<Zero Fill>

VI. DELIVERABLES, TASKS, AND SERVICES ASSOCIATED WITH GROUND SEGMENT

V.1 Deliverables Supplied by CNES to NOAA

V.1.1 Services

V.1.2 Equipment

Master Beacon, antenna, rack/cables

V.1.3 Documentation

V.2 Deliverables Supplied by NOAA to CNES

V.2.1 Services

Housekeeping for rack, connectivity for MB

V.2.2 Equipment

V.2.3 Documentation

VII. Related Documentation

The documents identified herein as “Applicable Documents”[AD-#] provide a source of the requirements for implementing the A-DCS capability at NOAA. Those documents listed as “Reference Documents” [RD-#] serve to provide references to additional information that clarifies or amplifies the contents of the PMOIP.

VII.1 Applicable Documents

[AD-1] Memorandum of Understanding Between the National Oceanic and Atmospheric Administration and the *Centre National d’Etudes Spatiales* for the Argos Data Collection and Platform Location System, Signed March 26, 1986.

[AD-2] Add MOU amendment for NOAA-N mission.

[AD-3] Add MOU amendment for NOAA-N’ mission.

[AD-4] Argos-3 System Technical Specification, AS3-ST-OS1-048 CNES, Draft dated January 28, 1998.

[AD-5] Specification *de la Balise de Telechargment* Argos/ADEOS II; ADII-SP-422-0007-CLS.

[AD-6] Radio environment specifications for the Argos-Next Master Beacon; ADII-SP-422-0057-CLS.

[AD-7] Installation Constraints with respect to the Master Beacon Argos-NEXT, ADII-422-0016-CLS

[AD-8] NOAA/NESDIS/OSO letter to CNES/Director for Programs and Planning, 18 Sep 2001.

VI.2 Reference Documents

[RD-1] Joint Project Plan – Space Segment for the Advance Data Collection System; dated 6 September 2001

[RD-2] Mission Operation Requirements for ADEOS-II Ground Segment (AD2-EOC-95-004), dated TBD

[RD-3] Agreement between the United States National Oceanic and Atmospheric Administration and the European Organization for the Exploitation of Meteorological Satellites on an Initial Joint Polar-orbiting Operational Satellite System, dated

[RD-4] NOAA KLM User guide

[RD-5] POES NOAA-J Pamphlet

[RD-6] DCS Space Segment Project Plan

[RD-7] CGMS LRPT/HRPT Global specifications

APPENDIX A

<u>A-DCS</u> Milestone Schedule

Design Reviews

- System Concept Review (SCR)	Completed	
- Preliminary Design Review (PDR)	Completed	
- Critical Design Review (CDR)	September 2001	

Instrument Delivery Schedule

- Flight Model 2 (FM2)	January	2002

APPENDIX B

LAUNCH SCHEDULE AND NEED DATES
(as of 5/01; subject to change)
[revise as necessary]

Spacecraft	Planning Launch Date	Spacecraft Need Date*	Instrument Need Date**
NOAA-N	March 2005	Delivered	Delivered
NOAA-N’ (pm)	March 2008	June 2004	July 2001

* S/C need date based on the planning launch date of the previous satellite.
** The date by which the instrument is required at the spacecraft contractor for integration on the spacecraft

APPENDIX C

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APPENDIX D

Acronyms List

A-DCS	Advanced Data Collection System
Argos	Data Collection and Location System (France)
ATN	Advanced TIROS-N
BTE	Bench Test Equipment
CCB	Change Control Review Board
CDA	Command and Data Acquisition Station
CDR	Critical Design Review
CEMSCS	Central Environmental Satellite Computer System
CNES	Centre National d'Etudes Spatiales
DCP	DATA COLLECTION PLATFORM
DCS	Data Collection System
DHS	Data Handling System
DOC	Department of Commerce
DRU	Data Recovery Unit
DTE	Downlink Test Equipment
DTR	Digital Tape Recorder
EMI	Electromagnetic Interference
EUMETSAT	European Organization for the Exploitation of Meteorological Satellite
FCDA	Fairbanks Command and Data Acquisition
GIIS	General Instrument Interface Specifications
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
HRPT	High Resolution Picture Transmission
JPPIG	Joint Project Plan Implementation Group
MOU	Memorandum of Understanding
NAGE	TIROS-N Aerospace Ground Equipment
NASA	National Aeronautics And Space Administration
NASDA	National Space Development Agency (Japan)
NESDIS	National Environmental Satellite, Data and Information Service
NOAA	National Oceanic and Atmospheric Administration

OSD	Office of Systems Development
OSDPD	Office of Satellite Data Processing and Distribution
OSO	Office of Satellite Operations
PDR	Preliminary Design Review
PMT	Platform Message Transponder
POC	Point Of Contact
POES	Polar-orbiting Operational Environmental Satellite
PSR	Pre Ship Review
PTT	Platform Transmitter Terminals
SAO	Systems Acquisition Office
SARP	Search and Rescue Processor
SARR	Search and Rescue Repeater
SCR	System Concept Review
SOCC	Satellite Operations and Control Center
STE	Special Test Equipment
TIROS	Television Infrared Observation Satellite
UHF	Ultra High Frequency
UIIS	Unique Instrument Interface Specifications

Appendix E

Argos Ground Segment Historical Background

Since the Argos system entered operational service in 1978, its ground segment has evolved considerably, particularly from 1986 onwards.

1978:
At its inception, the Argos ground segment was relatively simple. Users accessed their data via a telephone or telex link at a single processing center in Toulouse, southwest France. This center operated a main computer processing Argos data, and two secondary computers, one dedicated to acquiring telemetry and another for distributing data to users. The center was linked to NESDIS by a dedicated line operating at 9600 bps.

Three receiving stations (at Fairbanks and Wallops Island in the USA, and at Lannion in France) retrieved recorded telemetry. The Lannion station was used only to retrieve data downlinked from blind orbits. Lannion was not connected to the Argos processing center in Toulouse, but to NESDIS via the GOES satellite.

1985:
The Argos ground segment underwent few significant alterations until this date. Attention was focused on consolidating and sustaining the Argos system. The first major upgrades to the ground segment were initiated in 1985, when the two secondary computers were replaced by new-generation VAX 750s from Digital Equipment Corporation (DEC), running the VMS operating system. These systems formed the core of a new processing center architecture, the main concepts of which remain fundamentally the same to this day.

The NESDIS link was upgraded to 32 kbits and began using the X25 protocol.
Users could also access their processing center and retrieve data via X25.

1986:
Sweeping changes.
CLS was incorporated and the new company was immediately assigned the task of operating and promoting the Argos system.

The processing center in Toulouse was completely rebuilt around a cluster of three DEC computers, and Argos software was rewritten.

CLS set up its US subsidiary, Service Argos Inc. (SAI). The new subsidiary, located in Landover, Maryland, was equipped with a processing center identical to the one in Toulouse. The Argos ground segment now went global, with the two centers operating and backing each other up around the clock, all year round.

1988:
The advent of real-time data transmission. Users began to express an increasing need for faster data delivery. CLS decided to negotiate cooperation agreements with S-band antenna operators to retrieve TIP telemetry.

A first agreement was signed with Météo France, the French weather service, to use its receiving station in Lannion. Starting from 1988, this agreement gave CLS the capability to deliver local coverage all over Europe within less than 30 minutes, thus significantly enhancing performance.

At the same time, STIP telemetry delivered by the Lannion station was forwarded directly to the Argos processing center in Toulouse. The GOES link was taken out of service.

A second agreement was reached with NOAA's SOCC to operate specially designed equipment to receive TIP telemetry from Fairbanks and Wallops Island.

These three stations provided near-real-time coverage of Europe, the North Atlantic, and part of the United States.

1989:
CLS decided to relocate part of its operations to Australia to provide a more local presence for users. The objective was to develop Argos operations in Australia by offering closer technical and market support.

The first Argos regional processing center (RPC) was set up in Melbourne, located on the premises of the Bureau of Meteorology (BOM). This center, operating automatically and monitored remotely from Toulouse, initially only processed and distributed data from Argos PTTs operated by Australian users. It started processing and distributing data to New Zealand users soon afterwards.

Under another agreement with the BOM, the new RPC was able to receive TIP telemetry from the BOM's station in Melbourne. Additional telemetry was forwarded from the Toulouse center.

1991:
After Australia, CLS set up its second RPC in Tokyo, Japan. The objective here was the same: to provide a local service for Japanese users and to develop Argos operations in Japan.

1992–1998:
CLS continued its strategy based on cooperation agreements with organizations operating S-band receiving stations. For example, a new agreement was signed with the BOM to receive TIP data from stations in Casey, Perth and Darwin. A similar agreement was reached with Canada Environment to receive data from its stations in Halifax and Edmonton. In total, the Argos ground segment now comprised 20 receiving stations.

During this period, CLS continually upgraded its processing centers to provide more computing power, enhanced data security, and more secure backup. The Automatic Distribution Service (ADS) was developed in 1992 to deliver data automatically to users. This application was an instant success and is still very much a part of the Argos system today.

The Global Telecommunication System (GTS) application was also developed at this time. This application processes data from meteorological and oceanography PTTs and distributes them to the scientific community via the GTS, operated by the World Meteorological Organization (WMO).

1999:
CLS set up a new subsidiary in Lima, Peru, to process and distribute data from shipborne PTTs on Peruvian fishing vessels. Lima is the third Argos RPC.

Appendix F

Active HRPT Station in the CLS Regional Processing network